PATENT SPECIFICATION

(11) 1 439 191

1 439 191

(21) Application No. 21085/73 (22) Filed 3 May 1973
(31) Convention Application No. 255656 (32) Filed 22 May 1972
(31) Convention Application No. 260890 (32) Filed 8 June 1972
(31) Convention Application No. 260904 (32) Filed 8 June 1972
(31) Convention Application No. 302729 (32) Filed 1 Nov. 1972 in
(33) United States of America (US)
(44) Complete Specification published 9 June 1976
(51) INT CL[2] B29D 9/00//E04C 2/20
(52) Index at acceptance
B5A 1R14A 1R14B 1R14C2 1R14D 1R55
E1A 241
E1B 1A2D 1A3B 1C1B 1C1F 1E1B 1F12 1F7 1F9 1FX

(19)

(54) FABRICATION OF STRUCTURAL MEMBERS

(71) We, AUTOMATED CONSTRUCTION INDUSTRIES INC., a Corporation of the State of Arizona, of P.O. Box 19037, Phoenix, Arizona 85005, U.S.A.,

do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to the production line fabrication of structural members such as walls, roofs, and floors, and, in more specific respects, to the fabrication of walls, having pre-embedded elements, and the like from polymers and foamed materials.

In the production of housing, more efficient production techniques have replaced to some extent the age-old method of construction at the site from individual boards, stones, and other parts. However, modern plastics material and other polymers and similar material are not widely used as building materials, and the fabrication of walls, floors, roofs, and similar elements from such material is not satisfactorily efficient under prior techniques and results in deficiencies in the products.

Foamed plastic internal structures, such as of polyurethane foam, are recognized as desirable to provide excellent thermal insulation and satisfactory strength to the element at moderate cost. A major defect, however, has been experienced in that the strength of the final product is deficient at the bond between the foamed interior and the outer layer or "skin". In at least one technique which attempts to overcome this weakness, the foamed material is made more dense near the outer layer. Also, in the prior products foam frequently does not fill the entire interior, resulting in defects caused by the voids.

Although basic techniques to mass produce structural members are known and used, such as spraying a hardenable skin material within the mold surface, the cost of production is relatively high. The mold section must be held together by special equipment and, similarly, internal members such as electrical boxes and conduit, must be held in the mold cavities by special equipment.

Partition members such as walls, floors, and the like have been pre-assembled at a separate production facility or factory with pipes and other internal items pre-implanted. Construction of housing at the site is by joining the partition members together and connecting the pipes and other elements of adjoining members as required. Prior to this invention such pre-manufactured partition members have been in various forms, but none comprised a foamed polyurethane interior or core completely encased in a skin formed as a continuous layer of hardened polyester resin.

Foamed polymeric internal structures, such as of polyurethane foam, are recognized as desirable to provide excellent thermal insulation and satisfactory strength to the element at moderate cost. Difficulties have been experienced in the prior art with producing such a member having adequate stength. Hereinafter it is disclosed how to form a very satisfactory member with thin external outer layers and a foam internal core which can be produced at low cost and with good other economic factors. An assembly line production of a product in accordance with this invention is also described in which certain inserts, internal elements, and similar items are attached to the outer layer or held by braces or guides which are embedded in the foam. The internal items

are positioned at predetermined locations as a part of the production process.

According to the present invention, there is provided a method of fabricating structural members having opposed major surfaces and formed of a rigid polyurethane foamed core and a skin of a cured, hardened unsaturated polyester completely encasing said core as a continuous layer, which method comprises: providing a coating on all inner surfaces of a mould of a hardenable unsaturated polyester for forming the skin of the structural member; at least partially curing said polyester; and then introducing into the mould materials which react exothermically within the mould to form a rigid polyurethane foam filling said mould and bonded with the coating on the mould, said mould including a first mould part and a second mould part, each of said mould parts having a respective major surface, the coating being furnished on all inner surfaces of each of the mould parts while the major surface of each mould part is positioned substantially horizontally, and, after the coating is so furnished, the first mould part being connected with the secong mould part to form a mould cavity having the coating positioned on the total boundary of the mould cavity.

By the method of this invention it is possible to provide a structural member for housing using foamed material within an external layer and having adequate strength at satisfactory cost, which members can have pre-installed elements such as electrical boxes and electrical conduit. The method is especially suitable for assembly line techniques and provides also for uniformity in location of embedded internal members from wall section to wall section such that internal member similarly positioned in adjacently mounted wall members are in mating arrangement.

In accordance with a preferred embodiment of this invention the method is carried out using an assembly line through which mould frames are moved more or less continuously. Two mold halves are positioned initially with their bottoms horizontal, or any angle of incline such that the hardenable material does not flow to any significant degree, and any full diameter inserts such as windows and doors are rested in place. Certain inserts which are less than a full diameter can be placed in a predetermined position against the side of the mold. In the best embodiment, the predetermined position is against the bottom side of the mold such that inserts in adjacently positioned wall members will be in mating relationship. The molds are then sprayed or otherwise coated with a thin layer of a hardenable material, which preferably also contains a fire resistant filler such as hydrate of alumina. Any enclosed internal elements such as electrical boxes and water pipes are subsequently rested on the horizontal surfaces of the mold halves. A second thin layer of hardenable material is applied on the internal elements, this layer preferably containing glass fiber as filler. Soon thereafter the mating mold halves are brought to an inclined position, after the second layer has hardened sufficiently to hold the internal elements in an inclined position. The mold halves preferably contain complementary parts of a hinge at one side, which are connected together, and the molds are then rotated together and latched into place to form an internal, mold cavity. The mold is first preheated, and, with the mold in the vertical position, the foamable material is introduced into the cavity. The preheating brings the boundary temperature of the mold cavity toward that generated internally during the exothermic, foaming reaction. The mold halves are moved and supported by rollers as the foaming continues.

In accordance with this invention a wall member, floor member, or other structural member is obtained in which the internal core is a rigid foamed, polyurethane. Internal elements, such as water pipes, electrical conduits, and other electrical elements can be embedded in the foam polymer, as can be member which extend across the full diameter, such as door and window frames. The space relationship of such before-mentioned internal elements are controlled by their proper positioning in the mold prior to covering the mold surface and the internal member positioned partly in contact with the mold surface and wholly within the mold, with the polyester outer coating. Upon the partial curing of the polyester outer coating, the mold halves are brought together and the inner cavity is filled with polyurethane. In some uses it has been found satisfactory that some internal items such as junction boxes are embedded in the outer polyester layer to some extent and are held by the polyester during the foaming of the polyurethane to fill the mold cavity. Elements which extend across the entire member can be contacted by braces which extend from the sides of the inserts into the foam. The positions of the internal items can be standardized for direct access and economic use. The large, outer surfaces of the partitions may be thin layers of hardened polyester, may be textured to give a desired appearance such as stucco, building block, and the like. For some purposes, the outer layers of the partitions preferably may have plywood secured on one side. One such use for a plywood

surface is the floor surface. The plywood gives the floor a greater capacity for handling loads and a greater resistance to deformation.

The following is a description by way of example only and with reference to the accompanying drawings of preferred embodiments in accordance with the present invention. In the drawings:—

Figures 1, 2 and 3 in combination show different parts of a single plant production line layout for carrying out a method according to the present invention. The left side of Figure 2 is the area at which the right side of Figure 1 terminates, and the left side of Figure 3 is the area at which the right side of Figure 2 terminates.

Figure 4 shows a mold half in the horizontal position on the conveyor and a spray apparatus which applies the outer layer of material.

Figure 5 illustrates hinges joining of the mold halves.

Figure 6 illustrates a wall partition made in accordance with this invention having pre-embedded pipes for both hot and cold water extending across the wall.

Figure 7 illustrates a wall partition made in accordance with this invention having electrical conduit extending across the wall and a switch box and an outlet box located in contact with the outer layer.

Figure 8 illustrates a wall partition made in accordance with this invention having a door opening provided by an insert and having pre-embedded electrical conduit.

Figure 9 illustrates a wall partition made in accordance with this invention having a raceway for electrical wires located across the floor-adjoining side, the open side of the raceway being flush with the outer layer.

In the preferred production system, high quality structural members such as walls, roofs, and floors having a foam interior and good strength characteristics, and with functional elements built in, are produced efficiently in a factory. These improved features and characteristics are achieved with an actual financial saving in production costs over comparable prior systems.

The preferred system is a continuous one, but production can logically be thought to begin with the application of wax or other conventional release agent to the bottom of the mold halves 1. A thin coating of the release agent is sprayed on the surface of the mold halves 1 from the spray applicator 3.

In the final product the layers of one of the mold halves 1 will be the exterior surface of the wall or the like produced and the layer of the other mold half 1 will be the interior surface. As is known in the art, the surfaces of the molds 1 can be textured to give the desired appearance. The interior surface may be formed formed to simulate a desired interior material such as wood or stucco or other conventional interiors. The exterior may simulate building block, board and bat, or other conventional exteriors.

The mold halves 1 are guided by overhead rails 5, to which they are attached. As the lower ends of molds 1 encounter conveyor bed 7, they are guided by bed 7 and by the drop in height of rail 5 to a position at which the bottom of the molds halves 1 are relatively horizontal. The term "horizontal" is used hereinafter in the specification and claims to mean any convenient position such that the sprayed or coatings do not flow but remain substantially as sprayed on. The term "vertical" is used hereinafter in the specification and claims to mean any convenient position such that the filling and foaming of the material introduced into the mold is not impeded by the angle of inclination.

When the mold halves 1 are horizontal and prior to the location at which they enter the first coating stations 9, selected internal elements 11 are manually placed in the molds 1.

A preferred example of such an insert 11 which is placed directly against the mold surface is a raceway for electrical conduit. Such a raceway is shown in Figure 9 located across the floor-adjoining side of the wall, the open side of the raceway being flush with the outer layer. Switch boxes 66 and outlet boxes 64 are also placed flush against the surface of the mold. The conduit 62 is held away from the surface of the mold by its connections to the raceway 82, switch box 66 and outlet box 64.

During production, the inserts 11 are rested in the mold halves 1. The inserts 11 are stacked conveniently on a stand 15 located between the two conveyors. Certain of the inserts 11 such as the raceway shown with reference to Figure 9, does not necessarily extend across the entire diameter of the mold.

The mold halves 1 are continuously moved at about 8 feet per minute. They enter spray stations 9, and in spray stations 9 the surface is coated with a hardenable unsaturated polyester sprayed from a nozzle 17 (Figure 4) reciprocating from side to side, perpendicular to the direction of travel. The polyester is filled with a large proportion of hydrate of alumina or another comparable filler and the polyester resin itself, when hardened, is preferably a particularly fire retardant kind (a preferred resin has a B rating classification of 26 to 75). The material is applied evenly over the inserts 11, and in a quantity so that it will

harden to thickness of 1/32 inch with any tolerance variation being toward an increase in thickness.

The materials and spray techniques at stations 9 are basically well known and commercially employed.

The mold halves with internal elements 11 then move into spray stations 19. At stations 19, the material applied is a mixture of 20% by weight chopped glass fiber to 80% hardenable unsaturated polyester resin. The material and technique of application is otherwise substantially identical to that of spray stations 9. Such application of a second, under layer comprising a mixture of glass fibers and resin is essentially conventional. The material is applied over all areas, including the internal elements 11. Application is in amounts which harden to a thickness of 1/32 inch with any tolerance variation being toward greater thickness.

Immediately past spray stations 19 the applied layers are promptly traversed by rollers, as is conventional, to remove air bubbles and other discontinuities from the glass fiber and resin layer. Excess material is trimmed from the side of the mold halves shortly past stations 19 after the material has hardened.

The applied polyester material harden rapidly. As the mold halves 1 move continuously beyond spray stations 19, overhead rails 5 progress upward and the conveyor beds 7 guide the sides of the mold halves 1 so that the bottoms of the mold halves are moved to a "vertical" position. At that time the coated layers have hardened substantially, thus holding the inserts 11 in place after the bottoms of mold halves 1 are moved from the horizontal.

Overhead rails 5 take up a horizontal position at a high level so that the bottoms of mold halves 1 hang vertical. The molds halves 1 are then brought together manually to form the completed mold. As indicated in Figure 5, each mold half 1 contains one of two parts 25a and 25b of a hinge mechanism 25, which mechanism may simply comprise external sockets adapted to be interleaved, through which a pin is then manually inserted. The two mold halves are joined to form the hinge 25, pivoted together on hinge 25, and held together on the side away from the hinge 25 by a latch 27 or the like, all while still suspended from the rails 5. An internal mold cavity is thus formed with the hardened layers on the boundary of the cavity.

The combined molds 1 then enter the elongated curing oven 29. Oven 29 simply applies a preferred 150°F—170°F environment to the molds 1. The elevated temperature promotes further curing of the applied hardenable layers. The same operation brings the parts in which the core will be created by foaming to an elevated temperature, which has been found in accordance with this invention to produce very significant advantages.

The molds 1 leave the curing oven 29 and immediately reach the foam material introduction station 31. The preferred material used is a conventional material which reacts exothermically while in the molds to produce a foamed polyurethane. The reactive materials are introduced into the mold cavity in a liquid form through two or more open ports left in the top, as is basically conventional. Injection is preferably by a machine controlled froth or pour method of a pre-measured amount for the particular mold. The operator need only note the mold type and push a button to dispense the proper amount. (Injection is at not more than 50 pounds per minute per port to prevent slashing.)

Since the molds 1 are vertical, the material drops between the coated sides. As the automatic foaming reaction proceeds, the foamed product rises to the top and a small part may expand out through the open ports through which the foamable material was introduced, which is subsequently trimmed away.

The polyurethane foaming operation and product is conventional. Commercial materials are employed. The foam rises freely to form a foam solid of final weight density of 2.0 to 2.5 pounds per square foot. The reaction is self-initiating and sustaining, and exothermic. Temperatures within the molds rise to about 300°F. The reaction is fully completed in about 25 minutes, while internal pressure rises to 15 pounds per square inch in 5 to 8 minutes and drops to zero within 25 minutes.

During the time of the reaction, the molds 1 move between two, long facing rows of closely spaced, vertical rollers 33. The rollers 33 provide support to the bottoms of the molds 1 against the internal pressures produced by the foaming reaction and also provide a conveying device through which the molds 1 are progressed while the continuous production proceeds. Such a roller configuration, used similarly, is known in the art. The rollers 33 are driven directly while the overhead rails 5 are passive. The molds 1 filled with the foaming material are held in the conveyor rollers 33 thirty to thirty-five minutes to assure that complete curing has occurred while the molds 1 are supported.

The preheating of the molds 1 in oven 29 produces significant advantages over the prior art. The internal, foamed product serves as a structural support for the completed member. Studies incident to the

making of this invention have established that the polyurethane foam as it forms on the coated surfaces at ambient temperatures drags, sticks, rolls, and peels. The resulting bond between the foam and the coating is weak. When the temperature is raised in accordance with this invention, the foam appears to form in its final position on the layers bounding the mold cavity and the final bond is strong. This is highly significant since the strength of the bond between the core and the outer layer has been a basic problem in the prior art.

When the molds leave the vertical rollers 33, the mold halves 1 are separated. The finished product is grasped by a suction cup or the like of a conveyor 35, and moved aside to a storage area. The mold halves 1 are normally conveyed directly through another cycle as described.

The walls and other members are manufactured directly in sizes desired for complete housing units. In practice, walls would generally be constructed in dimensions from 11 feet long and 2 to 4 inches thick to the same thickness at 20 feet in length. To reduce the length produced, the same molds 1 may be used in conjunction with appropriate dividers 11 positioned at an end so as to shorten the effective length of the molds 1.

Where internal elements, such as electrical junction boxes, are to be accessible from the outside, the outer skin to them is simply trimmed away with a knife. In the case of the raceway shown in Figure 9, the raceway is automatically exposed since it was originally placed against the mold surface before the first layer of hardenable polyester is applied.

A typical member 51, a wall member, having water pipe pre-embedded is illustrated in Figure 6. The outer layer of the wall 51 is a hardened polyester about 1/16 inch thick. More specifically, the extreme outer layer is a polyester filled with a large proportion of hydrate of alumina or a comparable filler, the polyester resin itself being of a fire retardant kind having a B rating classification of 26 to 75. The layer is 1/32 inch thick with any tolerance variation being toward and increase in thickness. Intimately bonded to the extreme outer layer is a layer of 20% by weight chopped glass fiber and 80% hardenable polyester resin. That layer is also 1/32 inch thick with any tolerance variation being toward greater thickness.

The outer layer of polyester extends around the entire partition such as wall 51. A seam line 52 appears in the preferred embodiments which results from two halves being joined during the assembly process. In a preferred assembly process two mold halves, each carrying the partially hardened polyester outer layer for one half of the finished partition, each including all of one of the two large surfaces, are held together with the items to be embedded positioned in the mold cavity formed. The completed mold is positioned so that the large sides are vertical. Material which reacts to form a foam polymer is inserted into the cavity and the foaming reaction occurs. The outer layers are bound to the final item by the internal foam and also possibly somewhat by the intermingling of material where it touches during the final hardening. The mold cavity is elevated in temperature at the time of the foaming reaction, which results in improved strength and other physical characteristics.

In the wall member 51 a hot water line 53 and a cold water line 55 extend across the length of the wall 51. They are spaced somewhat from one another and are positioned approximately centrally across the thickness of the wall 51. In a typical member 51 the wall would be about two inches thick and the lines 53 and 55 would be about one inch from both the front and back surfaces. The lines have extensions 53a and 55a which extend out for connection to a facility requiring plumbing, such as a vanity.

The polyurethane may be a commercial material, preferably foamed to form a foam solid of final weight density of 2.0 to 2.5 pounds per foot of volume. In a preferred process the mold cavity is a pre-heated to 150°F—170°F. The foaming operation is self-sustaining and exothermic, and a strong bond results between the foam core produced and the outer, polyester layer.

Embedded water lines are pre-tested for leaks before use in a partition member. Walls with waste line are made thick enough to contain 3 or 4 inch lines.

Figure 7 illustrates another wall member 60 which is identical in many respects to that of Figure 6. The wall 60 of Figure 7 contains electrical conduit 62 connected to an electrical outlet box 64 and an electrical switch box 66. The conduit 62 is a small pipe, which may be metal or plastic depending on structural requirements and building codes and other factors. The conduit 62 terminates in the boxes 64 and 66 so that wires may be extended through the conduit 62 and enter the boxes 64 and 66.

The boxes 64 and 66 are embedded in the outer layer of the member 60. Specifically, in a preferred process, a mold is first coated with the outermost layers, as described in connection with Figure 6, comprising alumina or equivalent filler and material hardenable to a polyester. When that has hardened somewhat, junction boxes 64 and 66 are rested in the pre-established

positions for them. Then the layer of glass fiber filler and a material hardenable to a polyester is applied over the boxes and allowed to harden.

The conduit 62 is held by the boxes 64 and 66, spaced somewhat internally of the polyester outer layers. After the partition member is formed, the part of the outer layer outside of the boxes 64 and 66 is cut away around the boxes 64 and 66 to leave an opening to them. The foam polyurethane which fills the internal area supports all of the elements 62, 64 and 66 in the final partition member 60.

The conduit 62 includes a set screw connector 68 on one end to facilitate connection with the conduit of an adjoining wall member. Braces or guide elements, not shown, may be employed for maintaining a predetermined position for the ends of the conduits as they exit the member 51.

Figure 8 illustrates a different wall member 70 which is also identical in many respects to that of Figure 6. The wall 70 of Figure 8 contains a door opening 72 provided by a door frame insert 74 positioned across the thickness of the wall 70.

The door frame 74 provides a portal through the wall 70. Frame 74 may be of essentially conventional form and of material to provide the appearance desired, such as wood or an imitation wood. In contact with internal points of frame 74 and extending out into the foam interior from the frame 74 are several braces or guides 76. These resist movement of the frame 74 by external forces.

Construction such as that of the door is basically similar for other elements which extend completely across the partition, particularly for windows. In the preferred process for construction by assembly line, the frame insert 74 is rested in the mold before any of the material which forms the outer polyester layer is applied. The braces or guides 76 are then wedged firmly between the frame 74 and the sides of the mold. The internal foam forms around the braces 76.

Both Figures 8 and 9 illustrate variations in electrical element positioning and the use of a lower raceway to insert wires. The electrical boxes 64 and 66 and the conduit 62 are mounted as described in connection with Figure 7. In Figure 8 the conduit 62 is positioned in a path around the door 72. An exterior light outlet box 78 is located at the top, right-hand corner of the door 72.

Adjoining the floor on the sides of the door 72 in Figure 8 and across the entire bottom of the wall 80 in Figure 9 is a raceway or open face channel member 82, which is embedded in the wall partition where it meets the floor. In Figure 8 one member 82a and another member 82b is positioned on each side of the door. The raceway is conveniently exposed on one major surface of the wall 80 and on the bottom surface of the wall 80.

The raceway members 82 are elongated elements, preferably of a material such as aluminum, with square or rectangular cross section.

An open side, which will ultimately be closed by an insert or special molding, is flush with the outer side of the wall partition 70 or 80. The raceway member 82 can accommodate large amounts of electrical wire, which can be easily installed on location through the open front.

Finally, with regard to all members in accordance with this invention, the embedded items having an independent function are normally installed at predetermined locations defined by the locations desired for efficient production of housing by assembly of the partition members. Electrical outlets and the like are accordingly installed in final position. Items which are to be connected, such as conduit and pipe, are located where they will come together with a minimum of adjustment or additional steps.

The foam, polymeric interior when formed is a strong solid which supports and holds in place all of the embedded items.

Because of the materials used, the final structural member is highly resistant to moisture, insects and other organisms, and fire. It is strong and does not warp, and it exhibits very high thermal, acoustic, and electrical insulative values. Additionally, it is virtually free of corrosion and need for maintenance.

The expense of fabrication of the structural member is quite satisfactory when it is produced in accordance with this invention. Employment of the product for most building applications and uses appears to be practical in all respects, including economic factors and technical requirements, and this invention is accordingly considered to be a very beneficial contribution to the housing industry.

Certain of the structural members obtained by the method of this application are claimed in our co-pending Application No. 2003/76 (Serial No.).

WHAT WE CLAIM IS:—

1. A method of fabricating structural members having opposed major surfaces and formed of a rigid polyurethane foamed core and a skin of a cured, hardened unsaturated polyester completely encasing said core as a continuous layer, which method comprises: providing a coating on all inner surfaces of a mould of a

hardenable unsaturated polyester for forming the skin of the structural member; at least partially curing said polyester; and then introducing into the mold materials which react exothermically within the mold to form a rigid polyurethane foam filling said mold and bonded with the coating on the mold, said mold including a first mold part and a second mold part, each of said mold parts having a respective major surface, the coating being furnished on all inner surfaces of each of the mold parts while the major surface of each mold part is positioned substantially horizontally, and, after the coating is so furnished, the first mold part being connected with the second mold part to form a mold cavity having the coating positioned on the total boundary of the mold cavity.

2. A method as claimed in Claim 1, wherein said connecting step is a joining together of the first mold part with the second mold part at one location so that a hinged connection is formed between them and said mold parts are then rotated about said hinged connection so that the mold cavity is formed.

3. A method as claimed in Claim 1 or Claim 2 wherein hardenable unsaturated polyester resin is applied to the inner surfaces of the mould by spraying.

4. A method as claimed in any one of Claims 1 to 3 wherein said coating comprises two separate layers applied by a first coating step which forms a first layer of a hardenable unsaturated polyester resin and a second coating step which forms a second layer of a hardenable unsaturated polyester resin in admixture with fibreglass.

5. A method as claimed in Claim 4 wherein both of said first and second coating steps are by spraying.

6. A method as claimed in Claim 4 wherein the fibreglass is in a chopped condition.

7. A method as claimed in any one of the preceding claims wherein the polyester of the or the first coating layer includes a filler agent.

8. A method as claimed in Claim 7 wherein the filler agent is hydrate of alumina.

9. A method as claimed in any one of the preceding claims wherein said unsaturated polyester is fire retardant.

10. A method as claimed in any one of the preceding claims wherein air bubbles are removed prior to introducing the polyurethane foam by rolling of the coating surface.

11. A method as claimed in any one of the preceding claims wherein the materials which react to form a polyurethane foam are introduced into the mould by injection and/or pouring.

12. A method as claimed in Claim 11 wherein only a predetermined amount of said materials is introduced into the mould for assuring that the mould is completely filled and only a slight amount of materials overflow the mould.

13. A method as claimed in any one of the preceding claims wherein a first insert is positioned within the mould prior to introduction of the polyurethane materials.

14. A method as claimed in Claim 13, wherein the insert is positioned within the mold prior to the formation of the coating over the inner surfaces of the mold.

15. A method as claimed in Claim 13 or Claim 14 when said claims are appendant to Claim 4, wherein the insert is positioned within the mold after the formation of the first layer of the coating and before the second layer of the coating.

16. A method as claimed in any one of the preceding claims, wherein after the first mold part is connected together with the second mold part for forming the mold, the joined parts are raised to a position in which their major surfaces extend generally vertically and the foamable materials are introduced into the mold through the opening in the top of the mold such that the foamable material fills the bottom portion of the vertically positioned mold first and rises freely to the top.

17. A method as claimed in Claim 16, wherein once the materials which react to form a polyurethane foam have filled the mold, the mold is moved out of a foaming station into a holding station at which the sides of the mold are supported against internal pressure produced by the foaming reaction and the support is continued until the foam cure sufficiently so as not to deform the mold when the sides become unsupported.

18. A method as claimed in any one of the preceding claims which comprises heating the coated mold prior to introducing into the mold the materials which react to form a polyurethane foam to promote curing of the polyester and reduce dragging, sticking, rolling and peeling of polyurethane foaming material when introduced into the mold.

19. A method as claimed in Claim 18, wherein the heating step elevates the temperature of the coated mold to a temperature within the range of 150°F and 170°F.

20. A method as claimed in any one of the preceding claims wherein the or each layer of the coating is at least 1/32 inch.

21. A method as claimed in Claim 1 and substantially as hereinbefore described with reference to the figures of the drawings.

For the Applicants:
F. J. CLEVELAND & COMPANY,
Chartered Patent Agents,
Lincoln's Inn Chambers,
40/43 Chancery Lane,
London, WC2A 1JQ.

Printed for Her Majesty's Stationery Office, by the Courier Press, Leamington Spa, 1976.
Published by The Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from which copies may be obtained.

1439191 COMPLETE SPECIFICATION

6 SHEETS *This drawing is a reproduction of the Original on a reduced scale*

Sheet 1

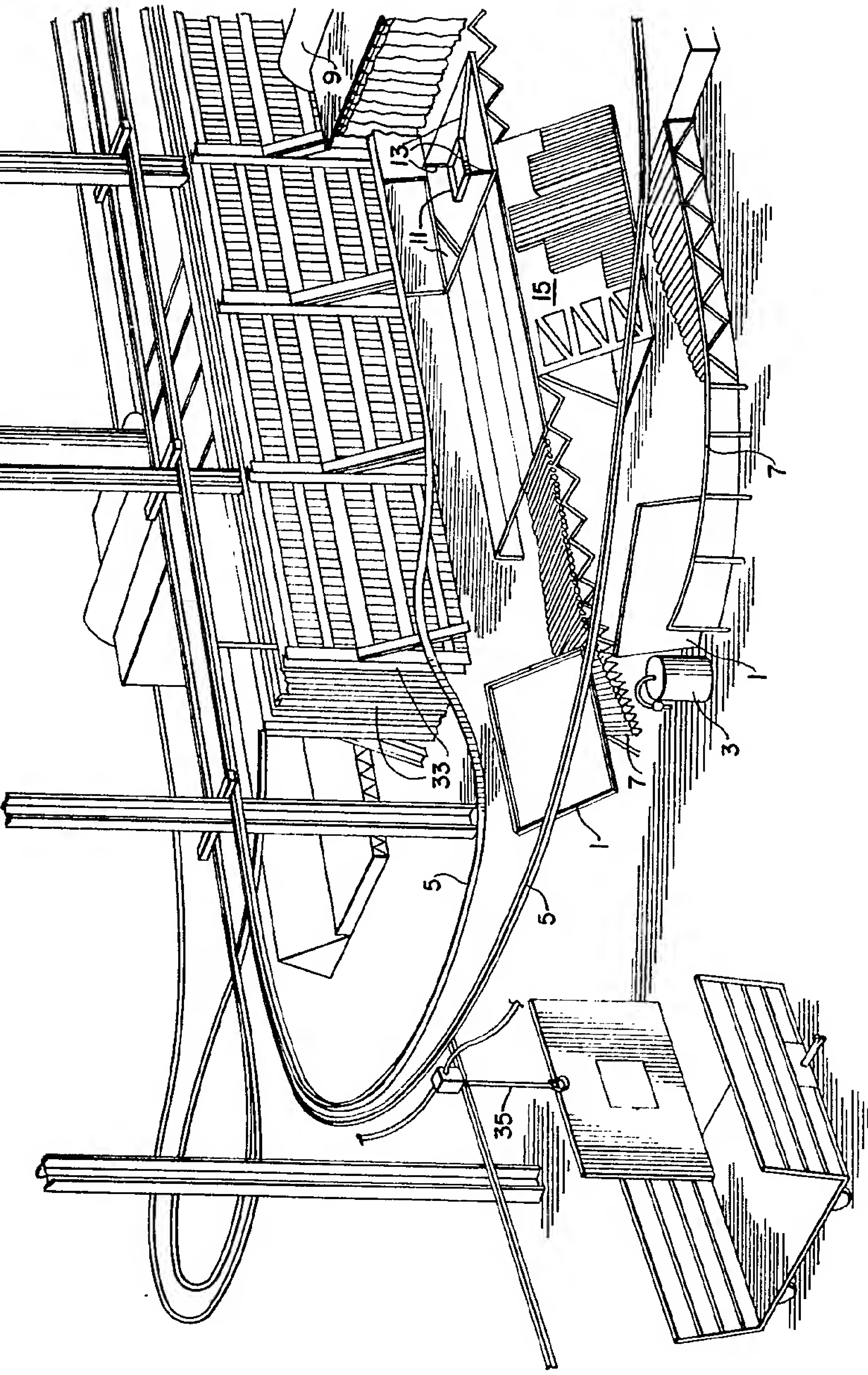


FIG. 1.

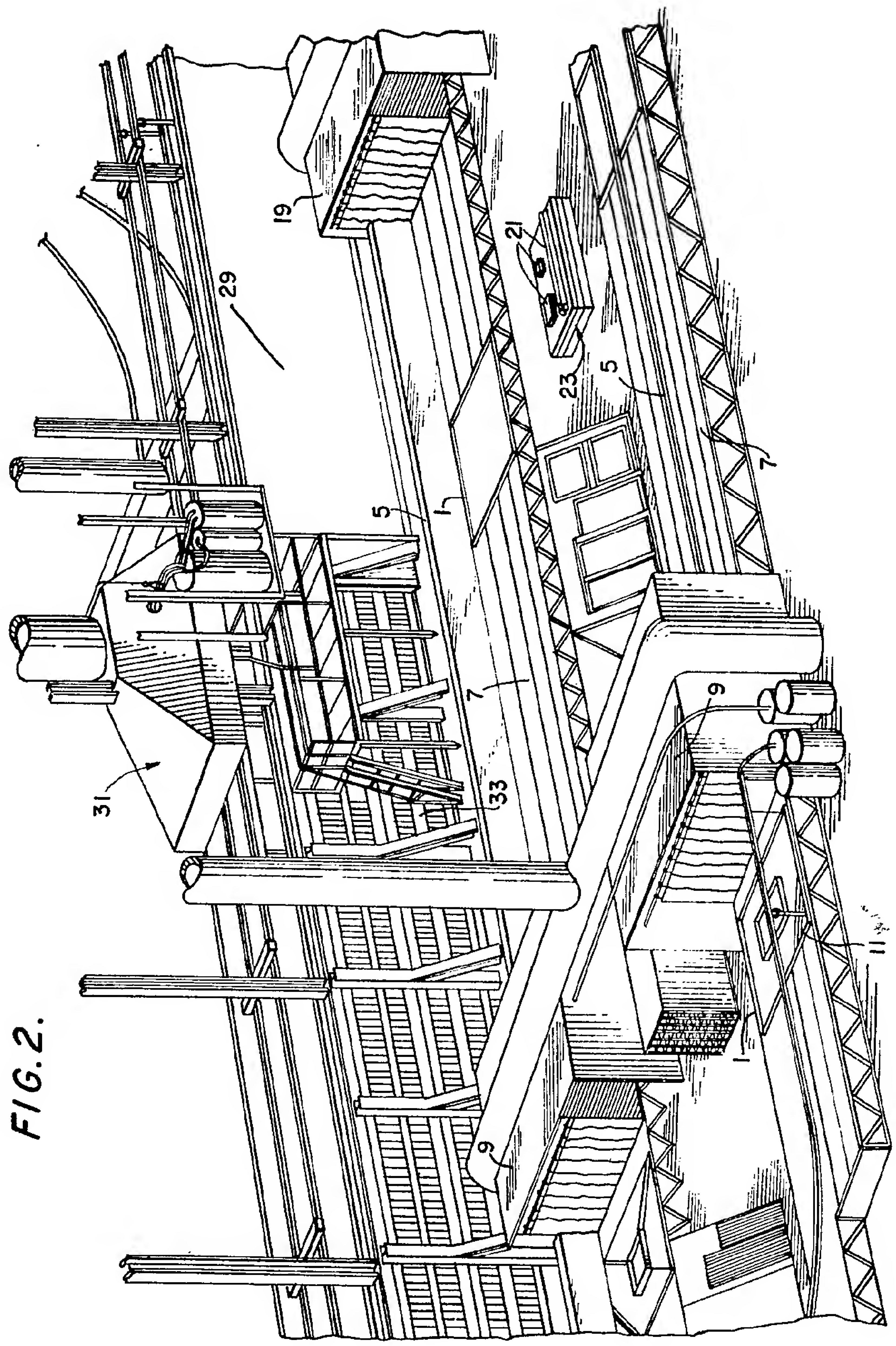


FIG. 2.

1439191 COMPLETE SPECIFICATION

6 SHEETS This drawing is a reproduction of the Original on a reduced scale

Sheet 3

FIG. 3.

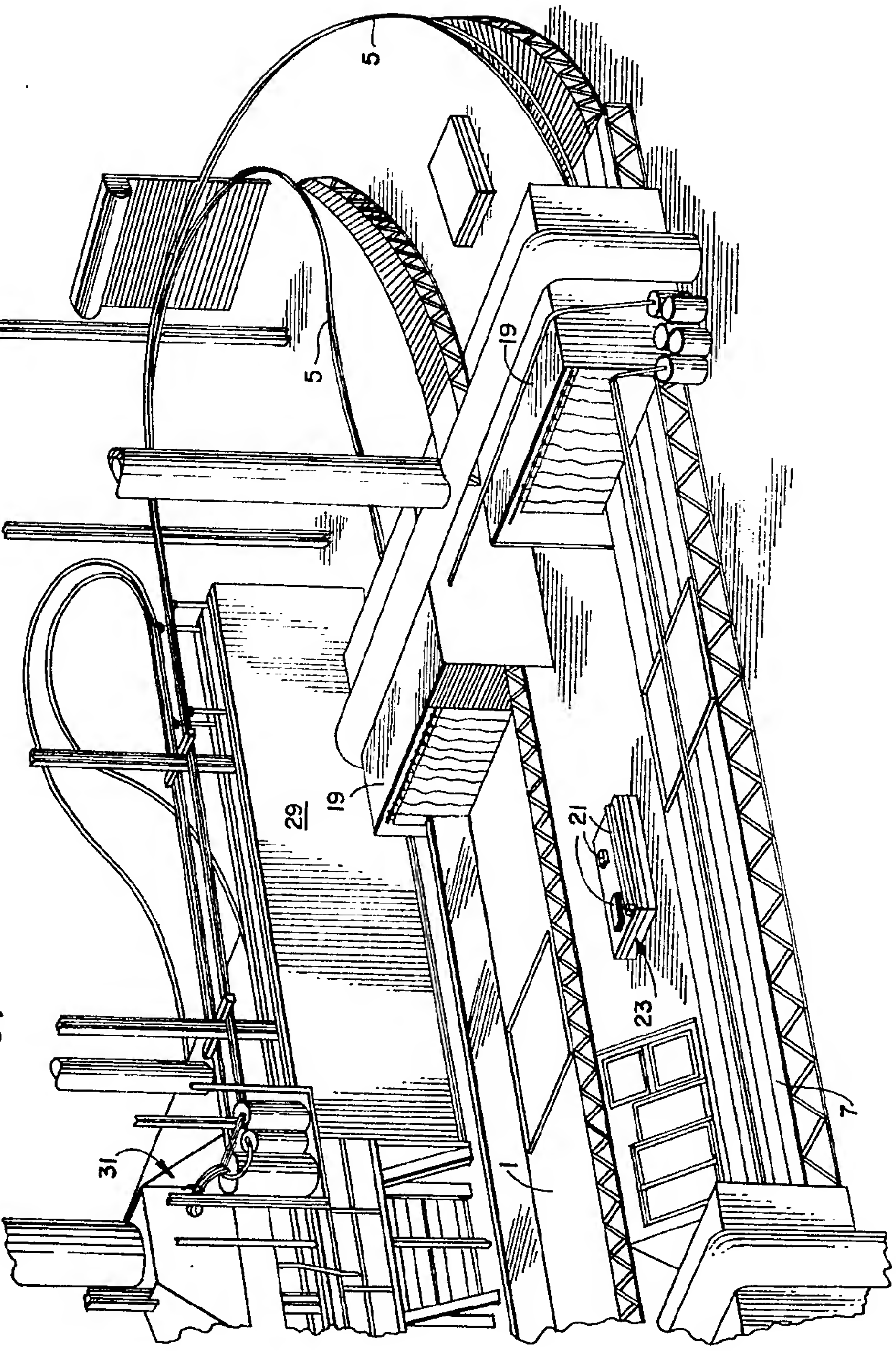


FIG.4.

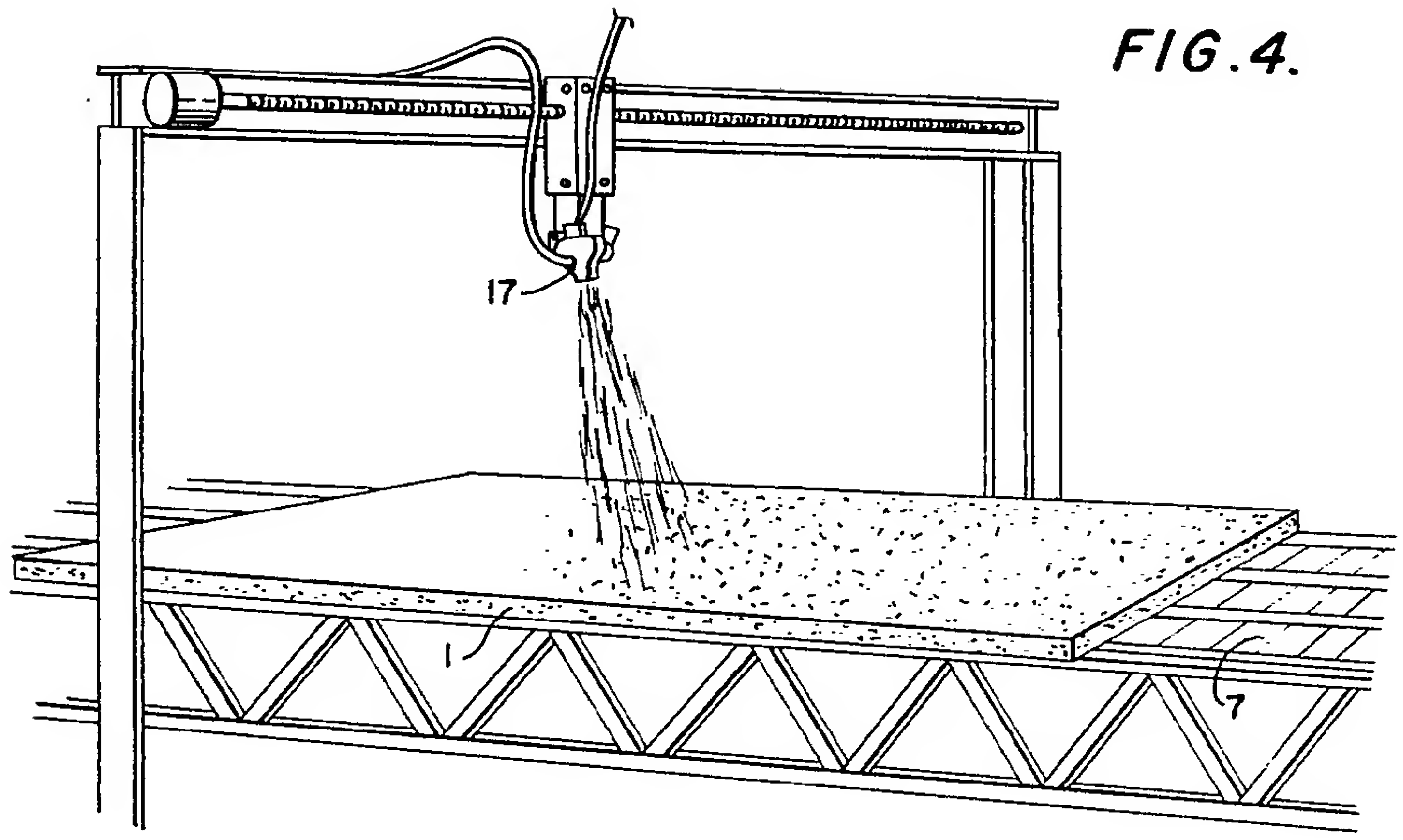
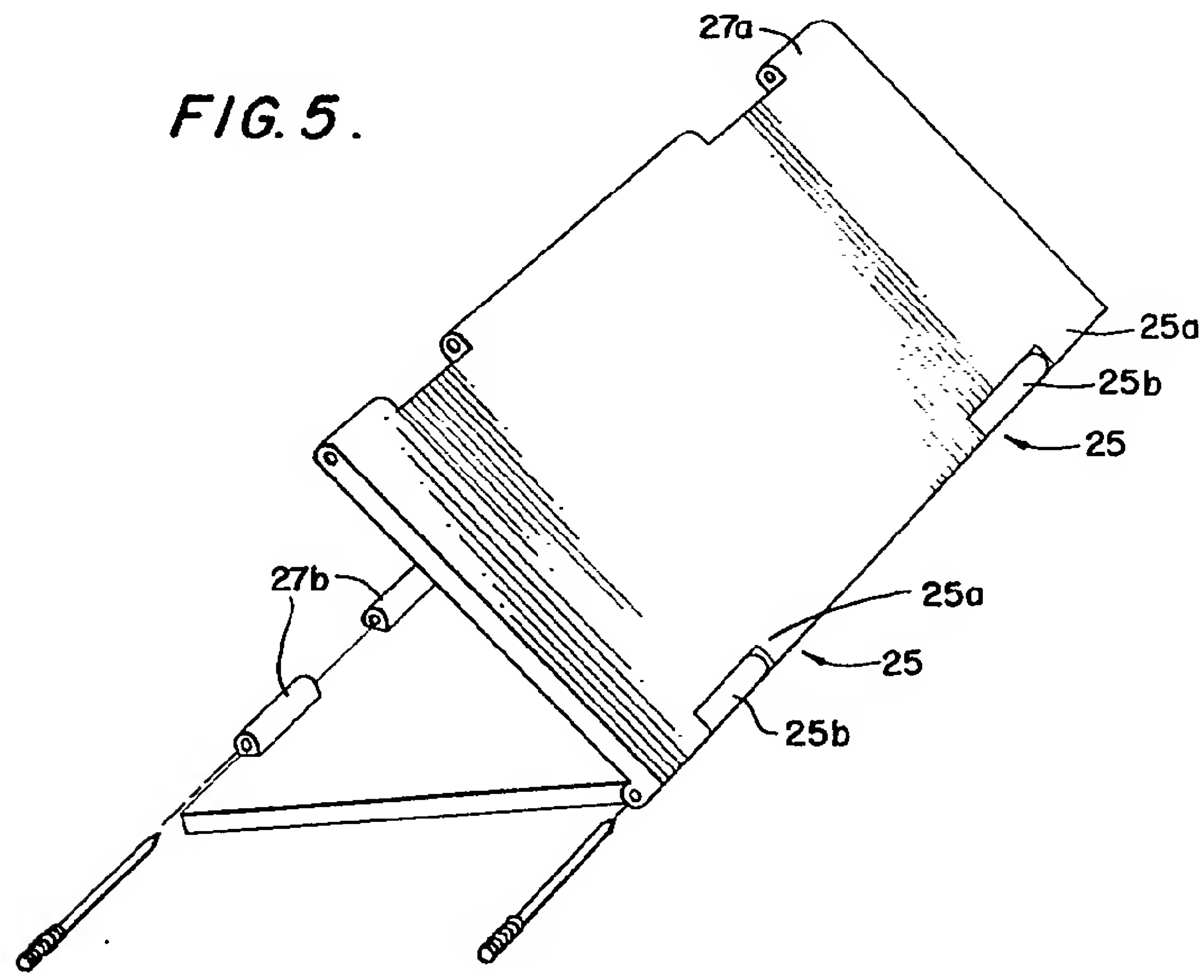


FIG.5.



1439191 COMPLETE SPECIFICATION

6 SHEETS This drawing is a reproduction of the Original on a reduced scale

Sheet 5

FIG. 6

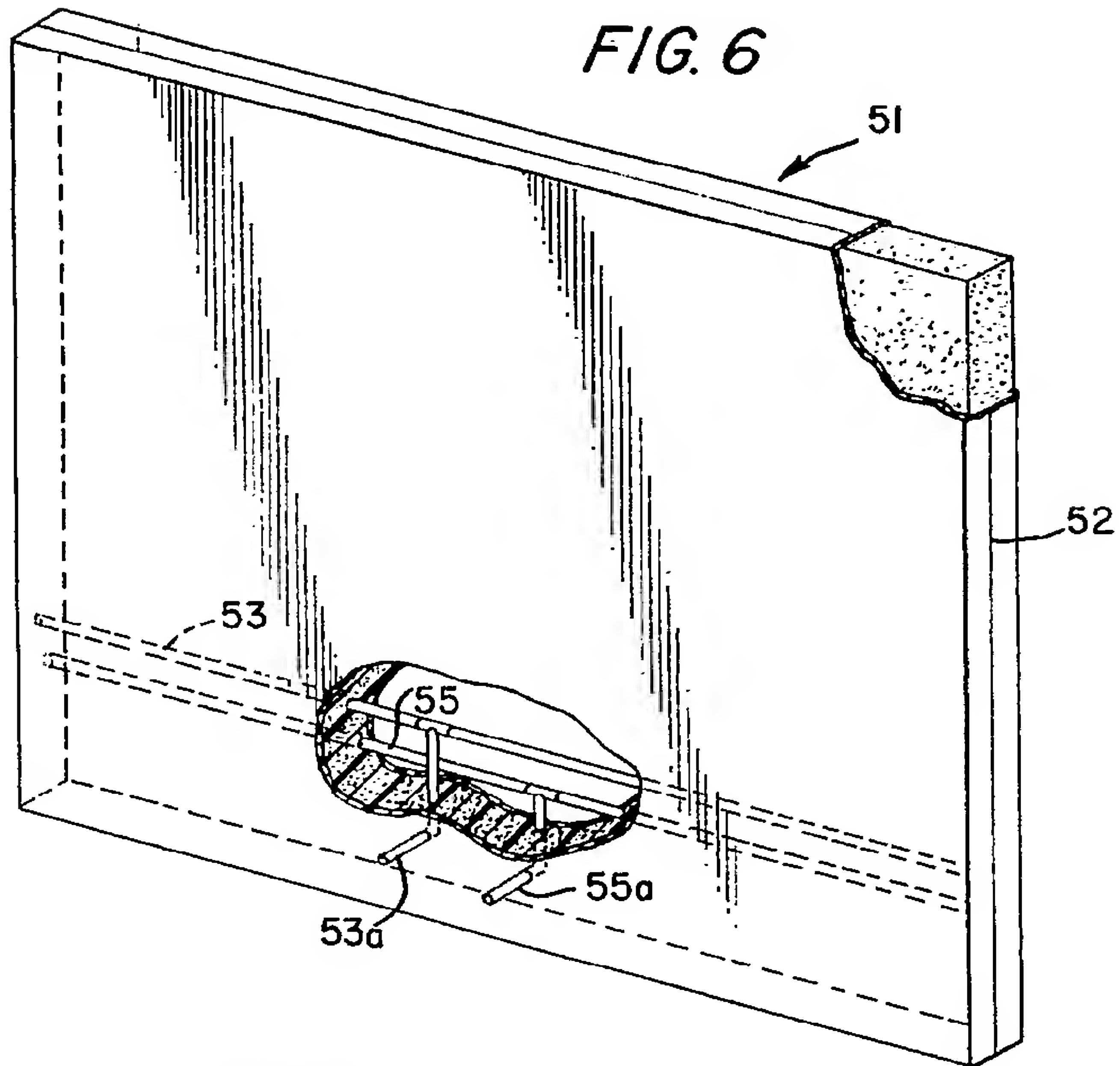
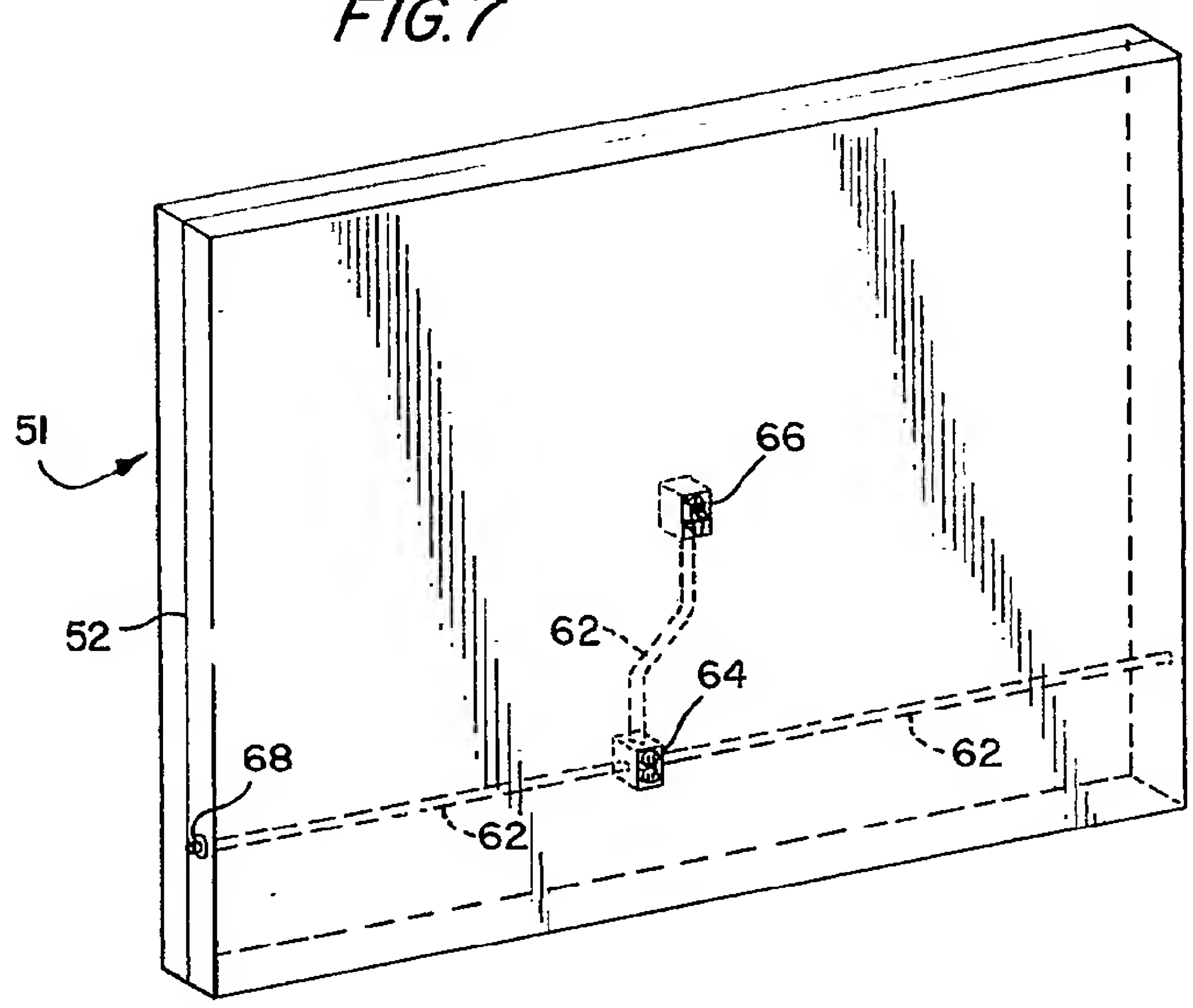


FIG. 7



1439191 COMPLETE SPECIFICATION

6 SHEETS This drawing is a reproduction of the Original on a reduced scale

Sheet 6

FIG. 8

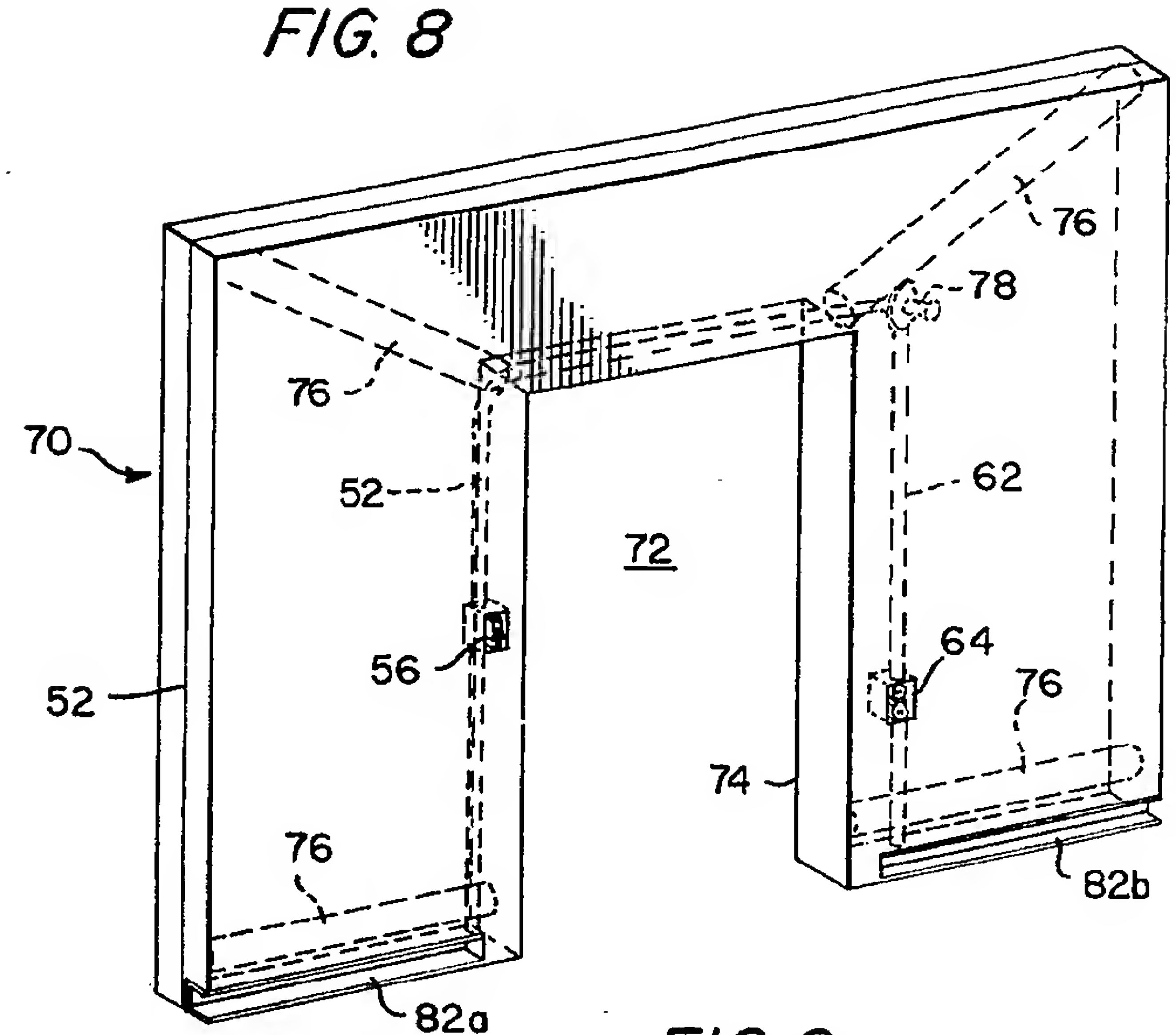


FIG. 9